How useful is routine amniotic fluid and neonatal surface swab microbiology at Caesarean section?

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Abstract: BACKGROUND: Our aim was to evaluate the clinical impact of routine amniotic fluid and neonatal surface swab microbiology at Caesarean section. MATERIALS AND METHODS: Microbiology data from 1 537 neonates delivered by Caesarean section were analysed in the light of clinical outcome. RESULTS: 1 340 (87%) neonates had non-pathogenic bacteria or negative culture results from both amniotic fluid and surface swab samples. Of the 197 (13%) neonates with pathogenic bacteria, 22 (1.4%) were diagnosed with infection, but only in 6 (0.4%) were the bacteria presumed to be responsible for the infection. Amniotic fluid and surface swab culture had sensitivities of 54% and 35%, and positive predictive values of 14% and 17%, respectively, for detecting a neonate at risk of infection. CONCLUSION: Amniotic fluid and neonatal surface swab microbiology at Caesarean section contributes little if anything to postnatal management and can be safely dropped from operative routine.

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How useful is routine amniotic fluid and neonatal surface swab microbiology at caesarean section?

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Abstract

Background: Our aim was to evaluate the clinical impact of routine amniotic fluid and neonatal surface swab microbiology at caesarean section.

Materials and methods: Microbiology data from 1537 neonates delivered by caesarean section were analysed in the light of clinical outcome.

Results: 1340 (87%) neonates had non-pathogenic bacteria or negative culture results from both amniotic fluid and surface swab samples. Of the 197 (13%) neonates with pathogenic bacteria, 22 (1.4%) were diagnosed with infection, but only in six (0.4%) were the bacteria presumed responsible for the infection. Amniotic fluid and surface swab culture had sensitivities of 54% and 35%, and positive predictive values of 14% and 17%, respectively, for detecting a neonate at risk of infection.

Conclusion: Amniotic fluid and neonatal surface swab microbiology at caesarean section contributes little if anything to postnatal management and can be safely dropped from operative routine.

Key words: amniotic fluid, surface swab, caesarean section, microbiology

Introduction

Early detection of neonates at increased risk of infection is of major clinical interest. Bacteriology of amniotic fluid samples and neonatal skin surface swabs at caesarean section was proposed as a predictor of infection during the first days of life [1, 2] and has been routinely performed in some institutions. However, there is ongoing debate as to whether isolates from these sources influence the development of neonatal infection and subsequent clinical management. Some authors have attributed adverse perinatal outcome to the bacteria isolated from amniotic fluid [3-9] and have proposed sampling amniotic fluid as an infection screening programme in preterms [3, 4]. Others have contended that bacterial invasion of the amniotic cavity does not increase the risk of neonatal infection [10-13]. There is even debate over the effects of Ureaplasma urealyticum on neonatal sepsis, meningitis and bronchopulmonary dysplasia [14-16].

Studies on this issue are rare. Most were conducted decades ago [1, 11] or limited to subgroups such as preterm neonates or mothers with premature rupture of the membranes [6, 7, 9]. More particularly, sample sizes were small [6, 11-13].

Our aim was to evaluate the utility of routine amniotic fluid and neonatal surface swab microbiology at caesarean section and its impact on subsequent clinical management, regardless of gestational age or other limiting factors. A key purpose was to determine the sensitivity and positive predictive value of the microbiology findings for neonatal infection.

Material and Methods

Patient population. In a retrospective study over 24 months (July 2003 – June 2005) we analysed the microbiology data of all 1719 neonates delivered via caesarean section at the Department of Obstetrics, University Hospital Zurich, Switzerland. We excluded 182 neonates on whom no amniotic fluid and skin surface microbiology had been performed. Gestational age in the remaining 1537 neonates ranged from 24 to 43 weeks (median 38 weeks). Median birth weight was 2890g (range 260g to 5000g).

Microbiological analysis and definitions. Amniotic fluid samples (n=1321) and neonatal cranial skin surface swabs (n=1486) were obtained at caesarean section. Amniotic fluid samples were transported (Portagerm®, bioMérieux, Marcy-l'Etoile, France) to the microbiology laboratory for immediate Gram staining, aerobic culture on Columbia sheep blood agar and chocolate agar, and anaerobic culture on Brucella agar (Becton, Dickinson & Company, Franklin Lakes, NJ, (BD)) enriched with thioglycolate broth (BD). A7 agar medium (bioMérieux) and Urée-Arginine Lyo 2© (bioMérieux), a ready-to-use urea- and arginine-containing broth-based system for detecting urogenital mycoplasmas, were used to detect Mycoplasma hominis and U. urealyticum. Surface swab samples were cultured aerobically on sheep blood agar, McConkey agar, colistin-nalidixic acid agar, chocolate agar, and streptococcal selective agar. Isolates were identified using standard procedures. Microbiology data from the amniotic fluid samples, surface swabs and follow-up samples (blood culture, cerebrospinal fluid and tracheal aspirate) were obtained from the Institute of Medical Microbiology, University of Zurich.

Culture results were divided into two broad groups with respect to the clinical context: pathogenic (e.g., Enterobacteriaceae, U. urealyticum and β-haemolytic Streptococcus group B, in any amount) and non-pathogenic (e.g., lactobacilli, coagulase-negative staphylococci and viridans streptococci, also in any amount). Classification of low-virulent

bacteria, i.e., mixed anaerobic bacteria, enterococci or peptostreptococci, depended on the amount present: low amounts or bacteria detected only on enrichment culture were classified as non-pathogenic; moderate or abundant amounts were classified as pathogenic. Negative cultures were pooled with the non-pathogenic results.

Clinical characteristics and definitions. Neonates were allocated to the following three groups: 1. No infection (no evidence of infection in the first six days of life); 2. Prophylactic antibiotics (administered over several days postpartum due to perinatal risk factors, e.g., mother positive for β-haemolytic Streptococcus group B, prolonged premature rupture of the membranes for >24 hours, and acute chorioamnionitis); 3. Infection (documented or suspected infection in the first six days of life). Clinical evidence of infection included respiratory distress syndrome, fever, hypotension, prolonged capillary refill time, hypoglycaemia and acidosis. Sepsis was diagnosed on the basis of a positive blood or cerebrospinal fluid culture combined with clinical signs. Clinical information was obtained from Zurich University Hospital's neonatal clinical database and individual patient records.

Statistical analysis. The sensitivity, specificity and positive and negative predictive value of a pathogenic culture result for detecting a neonate at risk of infection were separately calculated from cross-tabulations of the amniotic fluid and surface swab data. Pathogenic culture results were compared with non-pathogenic culture results. Neonates allocated to groups 2 & 3 (Prophylactic antibiotics & Infection) were considered together as at risk for infection and compared with those in group 1 (No infection).

Results

Neonate characteristics. Most neonates (1340/1537) had non-pathogenic or negative culture results from both amniotic fluid and surface swab (Figure 1). 1319/1340 neonates showed no signs of infection (group 1); six neonates received prophylactic antibiotics (group 2) and 15 developed an infection (group 3). Cultures of amniotic fluid, surface swab or both were pathogenic in 197/1537 neonates, 170 of whom belonged to group 1, five to group 2, and the remaining 22 to group 3 (Infection).

Analysis of the 22 neonates with infection and pathogenic amniotic fluid and/or surface swab cultures. Microbiological workup was performed in 20/22 neonates, in 14 of whom additional cultures were negative or non-pathogenic. However, in the remaining six neonates, cultures were positive for pathogens: β-haemolytic Streptococcus group B (n=1), Klebsiella oxytoca (n=1), Escherichia coli (n=2) and other bacteria (n=2); each isolate was identical to that cultured from the amniotic fluid or surface swab, thus presumptive of a causal relationship with the neonatal infection.

Microbiological analysis. In total, 1321 amniotic fluid samples and 1486 surface swabs were tested; 430 and 456, respectively, proved positive, in most cases for more than one microorganism. In amniotic fluid, the most frequent isolates were coagulase-negative staphylococci (n=180), U. urealyticum (n=100) and Propionibacterium spp. (n=43). Pathogenic isolates comprised β-haemolytic Streptococcus group B (n=20), M. hominis (n=15), Klebsiella spp. (n=5) and E. coli (n=4). Surface swabs grew skin flora (n=83), enterococci (n=43), coagulase-negative staphylococci (n=38) and viridans streptococci (n=31); well-known pathogens were β-haemolytic Streptococcus group B (n=34) and E. coli (n=14).

Amniotic fluid profile. 1167/1321 amniotic fluid cultures were non-pathogenic. 1149/1167 of these neonates belonged in group 1, six in group 2 and 12 in group 3.

Cultures of the remaining 154/1321 amniotic fluid samples grew pathogens; the neonates concerned were distributed as follows: group 1, n=133; group 2, n=4; and group 3, n=17. Pathogenic amniotic fluid culture had a sensitivity of 54% (21/39), a specificity of 90% (1149/1282), a positive predictive value of 14% (21/154) and a negative predictive value of 99% (1149/1167) for detecting the risk of neonatal infection.

Surface swab profile. 1399/1486 surface swab cultures were non-pathogenic. 1371/1399 neonates belonged in group 1, nine in group 2 and 19 in group 3. Cultures of the remaining 87/1486 swabs grew pathogens, with the neonates concerned distributed as follows: group 1, n=72; group 2, n=1; and group 3, n=14. Pathogenic skin swab culture had a sensitivity of 35% (15/43), a specificity of 95% (1371/1443), a positive predictive value of 17% (15/87) and a negative predictive value of 98% (1371/1399) for detecting the risk of neonatal infection.

Discussion

We evaluated the clinical impact of routine amniotic fluid and neonatal surface swab microbiology at caesarean section regardless of specific clinical constellation. Pathogens were detected in 197 (13%) of neonates, of whom only 22 (1.4%) developed an infection. To test for a causal relationship between the amniotic fluid and/or surface swab pathogen and the infection, we analysed the postnatal microbiology data and discovered that only in six cases were the resulting isolates identical to those grown from the amniotic fluid or surface swab. Thus pathogens detected at caesarean section can be presumed to have accounted for postnatal infection in no more than 0.4% of the total 1537 cases studied.

The detection of infection risk by culturing amniotic fluid and neonatal surface swabs had a sensitivity of only 54% and 35%, respectively. Sensitivities would have been even lower if we had not considered neonates receiving prophylactic antibiotics (group 2) at risk for infection. Moreover, the positive predictive values of 14% for amniotic fluid and 17% for surface swabs reveal a disconnect between pathogen detection and development of infection. This is consistent with reports of possible microbial invasion of the amniotic cavity without demonstrable clinical signs of neonatal infection [12]. Conversely, non-pathogenic cultures had high negative predictive values for infection: 99% for amniotic fluid and 98% for surface swabs.

Not only does routine amniotic fluid and surface swab screening have a low risk detection rate, it also provides no clinical information relevant to neonatal management. All 22 neonates identified with infection and amniotic fluid or surface swab pathogens had already been treated with antibiotics due to their clinical presentation and risk factors. In none of the 22 infected infants did the amniotic fluid or surface swab result influence monitoring, antibiotic initiation or antibiotic choice.

Our data show that routine bacteriology of amniotic fluid and the neonatal surface at caesarean section contributes little if anything to neonatal management. In our population, most of the neonates were delivered at term. However, for preterms or neonates with serious perinatal risk factors, amniotic fluid analysis might be useful to complement clinical examination and microbiological workup; its positive predictive value might improve in this setting. Skin swab analysis, on the other hand, has no value and should be discarded [4].

Conclusion

Routine amniotic fluid and neonatal surface swab bacteriology at caesarean section contributes little if anything to clinical management. In view of its financial implications, such screening should not be performed routinely.

References

[1]Poka R, Nagy G, Redai I and Lampe L. Clinical significance of amniotic fluid bacteriological cultures taken at caesarean section. Clin Exp Obstet Gynecol 1994;21(2):99-102.

[2]Thompson PJ, Greenough A, Gamsu HR, Nicolaides KH and Philpott-Howard J. Congenital bacterial sepsis in very preterm infants. J Med Microbiol 1992;36(2):117-20.

[3]Berger A, Witt A, Haiden N, Kretzer V, Heinze G and Kohlhauser C. Microbial invasion of the amniotic cavity at birth is associated with adverse short-term outcome of preterm infants. J Perinat Med 2003;31(2):115-21.

[4]Berger A, Witt A, Haiden N, Kretzer V, Heinze G and Pollak A. Amniotic cavity cultures, blood cultures, and surface swabs in preterm infants--useful tools for the management of early-onset sepsis? J Perinat Med 2004;32(5):446-52.

[5]Gibbs RS, Blanco JD, St Clair PJ and Castaneda YS. Quantitative bacteriology of amniotic fluid from women with clinical intraamniotic infection at term. J Infect Dis 1982;145(1):1-8.

[6]Kirchner L, Helmer H, Heinze G et al. Amnionitis with Ureaplasma urealyticum or other microbes leads to increased morbidity and prolonged hospitalization in very low birth weight infants. Eur J Obstet Gynecol Reprod Biol 2007;134(1):44-50.

[7]Yoon BH, Romero R, Park JS, Chang JW, Kim YA, Kim JC et al. Microbial invasion of the amniotic cavity with Ureaplasma urealyticum is associated with a robust host response in fetal, amniotic, and maternal compartments. Am J Obstet Gynecol 1998;179(5):1254-60.

[8]Watts DH, Krohn MA, Hillier SL and Eschenbach DA. The association of occult amniotic fluid infection with gestational age and neonatal outcome among women in preterm labor. Obstet Gynecol 1992;79(3):351-7.

[9]Yoon BH, Chang JW and Romero R. Isolation of Ureaplasma urealyticum from the amniotic cavity and adverse outcome in preterm labor. Obstet Gynecol 1998;92(1):77-82.

[10]Keski-Nisula L, Kirkinen P, Katila ML, Ollikainen M and Saarikoski S. Cesarean delivery. Microbial colonization in amniotic fluid. J Reprod Med 1997;42(2):91-8.

[11]Magrane DM and Blaskiewicz RJ. Amniotic fluid cultures: Post-cesarean section endomyometritis and neonatal infections. Obstet Gynecol 1983;61(3):339-43.

[12]Romero R, Nores J, Mazor M et al. Microbial invasion of the amniotic cavity during term labor. Prevalence and clinical significance. J Reprod Med 1993;38(7):543-8.

[13]Keski-Nisula L, Kirkinen P, Katila ML, Ollikainen M, Suonio S and Saarikoski S. Amniotic fluid U. urealyticum colonization: Significance for maternal peripartal infections at term. Am J Perinatol 1997;14(3):151-6.

[14]Hannaford K, Todd DA, Jeffery H, John E, Blyth K and Gilbert GL. Role of Ureaplasma urealyticum in lung disease of prematurity. Arch Dis Child Fetal Neonatal Ed 1999;81(3):F162-7.

[15]Cassell GH, Waites KB, Watson HL, Crouse DT and Harasawa R. Ureaplasma urealyticum intrauterine infection: Role in prematurity and disease in newborns. Clin Microbiol Rev 1993;6(1):69-87.

[16]Waites KB, Katz B and Schelonka RL. Mycoplasmas and ureaplasmas as neonatal pathogens. Clin Microbiol Rev 2005;18(4):757-89.

[17]Stoll BJ, Gordon T, Korones SB et al. Early-onset sepsis in very low birth weight neonates: A report from the national institute of child health and human development neonatal research network. J Pediatr 1996;129(1):72-80.